

Claims

1. A surface measuring apparatus for measuring a position on a surface of an element to be mounted thereon, comprising:
  - a measurement frame comprising a mount for mounting the element to be measured;
  - 5 - a stage comprising a rotatable device, the stage being movable in at least a first direction relative to said measurement frame; and
  - a contactless distance measurement device for measuring in said first direction a distance between said measurement frame and a predetermined measurement surface provided on said rotatable device,
  - 10 - said rotatable device further comprising:
    - a second distance measurement device, for measuring in a second direction a second distance between said device and a selected position on a surface of an element mounted relative to said measurement frame; and
    - a rotation measurement device for measuring an angle of rotation
  - 15 between said first and second direction.
2. Apparatus according to claim 1, wherein said measurement surface is rotation invariant.
3. Apparatus according to claims 1-2, wherein at least said first distance measurement device comprises an interferometer and said measurement
- 20 surface is formed by a reflective member that has a polyedric or circular shape over at least said measurement surface.
4. Apparatus according to claim 3, wherein said reflective member is comprised in a housing provided on said stage, and wherein said reflective member is coupled directly to said second distance measurement device, said

housing comprising a focusing member for focusing light from said first distance measurement device on said reflective member, so that a reflective light beam emanates virtually from the central axis of said reflective member.

5. Apparatus according to claims 3-4, wherein said focusing member is a cylindrical lens and said reflective member is cylindrical or wherein said focusing member is a spherical lens and said reflective member is spherical.
6. Apparatus according to any of the preceding claims 3-5, wherein said measurement frame comprises a reflective mirror, and wherein said stage comprises a beam splitting element, wherein a beam path of said first distance measurement interferometer travels directly between said reflective mirror, said beam splitting element and said reflective member, wherein said beam splitting element is coupled a light source, said beam splitting element further coupled to an interferometric light detector.
7. Apparatus according to any of the preceding claims, wherein said stage is movable in two orthogonal directions and said stage comprises a third distance measurement device for measuring in a third direction a third distance between said stage and said measurement frame, said third direction being orthogonal to said first direction.
8. Apparatus according to any of the preceding claims, further comprising a rotatable mount for mounting an element to be measured.
9. Apparatus according to claim 8, wherein said mount comprises a reference surface for allowing a measurement relative to said measurement frame.
10. Apparatus according to any of the preceding claims, wherein said second distance measurement apparatus comprises:

- an interferometric part for providing an interferometric measurement beam;
  - a movable focus part for focusing said interferometric beam on a selected position on said surface of said element;
  - 5 - an interferometric detector for receiving said interferometric beam from said selected position and for measuring a distance between said interferometric part and said selected position;
  - a unit for automatically moving said focus part to an in-focus position; and
  - 10 - a focus distance measurement device for measuring a relative position between said focus part and said interferometric part..
11. Apparatus according to claim 10, wherein said focus distance measurement device comprises an inductive and/or capacitive distance meter or a glass lineal or the like.
- 15 12. Apparatus according to claim 10, wherein said focus distance measurement device is coupled to said interferometric detector in order to provide an absolute zero-level to an interferometric measurement performed by said detector.
- 20 13. Apparatus according to claim 11, wherein said focus distance measurement device comprises a distance meter for measuring a relative distance of the interferometer relative to the auto focus
14. Apparatus according to claim 10 - 13, wherein said second distance measurement interferometer comprises a tilt detector for detecting a level of tilt of said element to be measured.
- 25 15. Apparatus according to claim 14, wherein said tilt detector is arranged to detect a level of tilt of the element to be measured in a direction orthogonal to said first and second directions.

16. Apparatus according to claim 14 or 15, wherein said tilt detector is coupled to said stage, so as to position said second distance measurement device orthogonally to a measured contour of said element.

17. Method for measuring a position on a surface of an element, comprising:

- 5    - providing a measurement frame;
- providing a stage movable relative to the frame and comprising a device that is rotatable relative to the stage;
- providing a predetermined measurement surface on said rotatable device;
- 10   - measuring directly in a first direction a first distance between said measurement frame and said predetermined measurement surface provided on said rotatable device;
- measuring in a second direction a second distance between said rotatable device and a selected position on a surface of an element mounted
- 15   relative to said measurement frame; and
- measuring an angle of rotation between said first and second direction.